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A System for Making Selective Matings in Dairy Cattle

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A SYSTEM FOR MAKING SELECTIVE MATINGS IN DAIRY CATTLE

BY

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This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and acceptable as meeting the thesis requirements for this degree; but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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INTRODUCTION

The term "selective matings" implies the selection of a sire to breed to each female on an individual, rather than a group or herd basis. Mating systems, other than random mating, may be classed either as the mating of like to like or as the mating of unlikes. This likeness or unlikeness may be based either on blood relationship or on individual appearance.

The advantages and limitations of each mating system have been well worked out on a theoretical basis, and some of the systems have been thoroughly tested by experimentation and in the field. In actual practice many breeders use a combination of two or more of these systems.

The perfect mating system or combination of mating systems has not been found, and because of the complexity of the problem there probably could be no perfect system that would work in all herds. Nevertheless, any system that could increase the percentage of desirable offspring enough to make an economic gain for the breeder without harming the breed as a whole would seem to be worth consideration.

It is unlikely that any recently devised system of mating could be considered new in principle. The system with which this thesis deals is one involving the mating of unlikes based on the individual appearance of the animals. This may also be called corrective mating, compensatory mating, or negative assortive mating on the basis of somatic resemblance.

Breeders of all classes of livestock have long used the mating of unlikes as an effective method of correcting defects in their herds.

Many examples, such as the use of long stretchy boars for improving conformation when the sows are short and fat, could be cited to illustrate the mating of unlikes. All of these illustrations, however, would involve the same general principle - that of mating each animal to one which is equally extreme but in the opposite direction in order to increase the tendency for obtaining the desired intermediate in the offspring.

The specific system studied here is an application of this principle to dairy cattle. It is known as the Animal Analysis Associates system of analyzing dairy cattle. This system will hereafter be designated by its trademark - a.A.a.

The a.A.a. program was originated by William A. Weeks of Rockford, Illinois, formerly a Holstein breeder in partnership with his father in Vermont, and also a former official classifier for the Holstein-Friesian Association of America. Mr. Weeks started his analyzing program on June 21, 1950. Five other men became analyzers the first year, and by July of 1951 approximately 429 Holstein herds in 16 states had been analyzed.

At the present time the total number of herds that have had some work done by a.A.a. exceeds 5,000. Over 100,000 animals have been analyzed, 90 percent of them are Holsteins, and most of these Holsteins are registered. The a.A.a. staff has grown to 11 men distributed throughout the dairy regions of the United States.

The opinions of dairymen regarding the a.A.a. system vary greatly. Very little, if any research data have been published on this system. A controlled breeding experiment for determining the merit of a mating

system such as this would require a great deal of time and expense. The only available data for studying the a.A.a. system were to be found in the various herds where the system has been in use for several years. Therefore, it was decided that a survey of the herds using the a.A.a. system should be conducted.

The objectives of the study described herein are as follows:

(1) To gather data and information on the a.A.a. system for determining whether or not the system has merit in the breeding of better dairy cattle.

(2) To determine whether or not the a.A.a. system can be learned by others.

(3) To study the feasibility of carrying out a controlled breeding experiment to determine the merits of the a.A.a. system.

(4) To determine the acceptance of the a.A.a. program by the breeders and artificial insemination associations.

The Animal Analysis Associates System

The present a.A.a. system, after revision in 1954, analyzes the conformation of each dairy animal for front end character, udder character, and rear end character. Each of these three divisions of the animal is given an "R" (round) or an "S" (sharp) designation depending on whether the characteristics of the animal's conformation are round or sharp as described in Table XVIII, Appendix I. Any animal therefore may be designated as an RRR, an SSS, or one of the six combinations such as RSR, SSR, RSS, etc.

Since this is a system for the mating of unlikes, each animal should be mated to its opposite: an RRR with an SSS, an RSR with an SRS, etc. A "perfect" mating is one where the animals are direct opposites. This is also known as a No. 1 mating. Other possible types of matings in order of their decreasing desirability are the 3/3 mating, 4/2 mating, 5/1 mating, and the 6/0 mating. A 3/3 mating is one involving three S's and three R's. A 4/2 mating contains four of one and two of the other; a 5/1 mating contains five of one and one of the other; and a 6/0 mating involves all S's or all R's.

An oversimplified but easily understood explanation of the system is that an extremely round dairy cow resembles a beef cow, and the extremely sharp dairy animal resembles a goat in conformation. A similar explanation is that the extremely round animal resembles the geometrical circle; the extremely sharp animal resembles a wedge; and the objective of the system, the true type cow, resembles an equilateral triangle. The true type cow therefore is considered an intermediate between the round and sharp animals.

Figures 1 and 2 in Appendix I show the analysis card used by the analyzers and a sheet of drawings describing the a.A.a. system.

REVIEW OF LITERATURE

Two popular articles on a.A.a. have appeared in the Holstein-Friesian World (40,42), however no published research data on this system could be found. Because of this, and the deficiency of literature in the field of compensatory matings, it was decided that a broader area should be included in this review. Each area reviewed is concerned with the mating system under study in one way or another, either through the economic relationship of production to conformation or directly, through the research on body conformation. The section on hybridization was included since hybridization differs from mating of unlikes within a breed only in degree.

Since the a.A.a. system groups together the front end characters, udder characters, and rear end characters, sections on linkage and pleiotropy seemed desirable. The section on physiological body balance contains information pertaining to what is perhaps one of the most important concepts of the a.A.a. system.

Correlations in Dairy Cattle

Relationship Between Type and Production

Aside from esthetic values, dairy cattle type is important to us only insofar as it can be related to the economic production of milk. Production in dairy cattle results from the harmonious balancing and functioning of the various organs and glands. At best, external appearances can give only clues as to the functional activity of these same organs and glands.

Type is dependent upon the proportions and blending of all of the anatomical parts of the animal. Type is the result of growth phenomena, since the development of any body part is due to the activity of the growth organizer (s) for that part. The extreme likeness of monozygotic twins seems to prove the importance of heredity in type (11).

Harvey and Lush (14) estimated the correlation between transmitting ability for type and transmitting ability for production to be 0.18 from data on 2,786 daughter-dam pairs in the Jersey breed.

Stone et al. (34) obtained the following heritabilities: type rating, 0.21; mature equivalent milk, 0.25; mature equivalent fat, 0.27; and butterfat percent, 0.35.

From an analysis of components of type in several different studies it was found that dairy character showed a higher correlation with production than any of the other breakdown items, and it was also higher than for over-all rating. These correlations between dairy character and production ranged all the way from 0.14 to 0.84, and one genetic correlation was 0.98 although this was inconclusive due to a lack of confidence (39) in the components of the correlation coefficient. Scores for feet and legs and for rump showed the least association with production (21,29,37,39).

One complicating factor in the above information is the fact that the heritabilities for dairy character and for rump were found to be 0.06 and 0.31 respectively (29). While there is no genetic antagonism between good type and high production, selection for type alone will have little direct influence on production, and conversely, selection for production alone will have little direct influence on over-all type rating.

Selection on type alone would require about six to ten generations to obtain the improvement that selection on the basis of production would obtain in only one generation (14,21).

Relationship Between Type and Lifetime Production

It has been observed (16) that certain types of legs and feet appear to be prone to injury, infection, crampiness, and other dysfunctions. Such dysfunctions may impair the economic usefulness of the animal during its life; they may also be responsible for the eventual elimination of once high productive animals. The effect of these dysfunctions of the feet and legs on the milk production of the affected cows has been recognized. Noticeable drops in production of some of the affected cows for a short period of time have been observed. Differences in the frequency of such troubles may be expected to occur among animals of different sizes, large animals being more susceptible to such injuries than small ones (16).

According to Hyatt et al. (18), the lives of many dairy cattle are greatly shortened because of poorly shaped udders that break away from the body at an early age and are easily injured and susceptible to mastitis. In the Reymann herd at West Virginia some of the families were so badly sickled in their legs that they had to be removed from the herd by the time they were six or seven years of age.

In a study recently completed at Beltsville, Parker et al. (30) found that the heritability of longevity in Holsteins and Jerseys was practically zero. They also concluded that no real improvement in longevity could be expected by improving the type of the dairy animals.

Relationship Between Size and Production

There has not been a great deal of research conducted on the correlation between size and production in dairy cattle. Nevertheless, the latest changes made on the true type score card by the Purebred Dairy Cattle Association include several items which call for greater attention to size.

Blackmore et al. (5) found that negative genetic associations existed between milk production and all measures of body size except wither height. This indicates that any effort to select for milk production alone would lead to animals with reduced chest girth relative to wither height, reduced chest depth, body length, and weight.

Data collected at Illinois offer no evidence that size and type are genetically positively correlated with production and, indeed, point in the opposite direction as far as size and milk production are concerned. In this study, however, the age corrections would have indirectly removed such correlation as may exist because of the positive correlation between age and size (35).

According to Seath (33), Iowa DHIA cows having estimated body weights of 600 pounds or less and 1500 pounds or more were more heavily culled than intermediate sized cows, however no definite conclusions were drawn.

Much of the observed relationship between size and production in many herds could probably be traced to various environmental factors. Certainly, with the present lack of conclusive evidence we could not justify selecting for size as a means of improving production in our dairy cattle.

Type Ratings With Different Ages, Seasons, Lactations, Classifiers and Years

One should keep in mind, when correlating type ratings with production, that these ratings are based on the frequently changed true-type score card. The literature has suggested that they may be influenced by many factors such as age of animal, stage of lactation, degree of fleshing, and also by the difference in classifiers.

Work done at West Virginia showed that type ratings of heifers prior to calving might be useful because the low group of heifers remained the lowest following calving and the highest group remained the highest; however, both averages as cows were closer to the general mean than their averages as heifers (17).

Clifton et al. (6) found definite characteristic age changes in all score card divisions for heifers. The most consistent of these were a progressive improvement in shoulders and chest, a drop in scores for rump and thighs between six and twelve months, and a marked improvement in feet and legs between three and six months.

Hyatt et al. (17) found that the correlations between the average of the several ratings for heifers before first calving and the first and second ratings after calving were 0.37 and 0.40, respectively. Benson et al. (3) found repeatabilities for heifer ratings to be in the range of 0.20 to 0.28.

Most workers are in general agreement that the type rating on a heifer is a rather weak indication of what the type of the mature cow will be (17,18,19,31,44). Two ratings had an advantage over one for

predicting future type but little if any more seemed to be gained from using more than two ratings (19).

Repeatabilities of type ratings on dairy cattle of 0.34, 0.48, 0.55, 0.56, and 0.69 have been found by various workers (3,19,42). Repeatabilities of breakdown ratings varied from 0.23 to 0.61. Consecutive ratings were found to be only slightly if any more alike than ratings separated by two, three, and four years (3,19).

Some studies have shown classifier effects to be high, 26.16 percent of the total variation, and a range among classifiers of 1.38 ratings (43,45). Other studies have found rather small differences among classifiers and it was concluded that the cows very definitely change in classification from one time to another (28,36).

Defects in udder, feet, legs, and health of the cow appeared to be the main causes of wide variations in type ratings. Apparently the udder, feet, and legs are the hardest to evaluate and the inspectors varied greatly in their deductions for these important defects (18,19,21,43).

Variations between type ratings due to age, stage of lactation and degree of fleshing were real as reported by various stations. Overall ratings increased steadily with age with a range of 0.92 of a rating between lactation number one and six plus. Wilcox et al. (45) found spring ratings to be higher than fall by 0.07**; however Benson et al. (3) found no difference between seasons. Early and late-lactation scores were higher than mid-lactation by 0.13* and 0.17** of a rating. Trends

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*Significant ($P < 0.05$).

**Highly significant ($P < 0.01$).

among subratings were similar except that feet and legs, and fore udder, showed smaller age and greater classifier effects; dairy character decreased (0.17**) and body capacity increased (0.27**), in late-lactation (45).

Relationship Between Various Body Parts

Some interesting research done by Leighton and Graves (22) on the relationship between slope of rump and slope of udder floor showed a correlation coefficient for the relationship of the degree of inclination of the rump to the degree of inclination of the udder of +0.021 ± 0.11; the correlation coefficient for relation of degree of sloping rump to producing ability was -0.013 ± 0.107; the correlation coefficient for relation of degree of inclination of the udder to producing ability was -0.196 ± 0.103. None of these coefficients was significant.

It was formerly believed by many that if a cow's rump sloped, her udder would also slope because the udder gets its support from the bone structure of the pelvic region. The evidence indicated above however does not support this belief.

A correlation coefficient on the relation of the degree of inclination of the rump to the number of services per conception was +0.220 ± 0.088. While hardly significant, this coefficient does show a more pronounced trend than the other three coefficients (22).

Freeman and Dunbar (9) have indicated the following heritability estimates for ten components of type and final rating: head and neck, 0.30; feet and legs, 0.18; udder size and shape, 0.08; udder attachments,

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**Highly Significant ($P < 0.01$).

0.06; udder teats, veins and quality, 0.27; general quality, 0.13; breed character, 0.32; and final rating, 0.31.

Touchberry (35) found that the heritability of each characteristic and the phenotypic and genetic correlations between the different characteristics, wither height, chest depth, body length, and heart girth, had heritabilities of 0.73, 0.80, 0.58, and 0.61, respectively, while heritabilities for paunch girth, weight, milk production and fat production were 0.26, 0.37, 0.25, and 0.35. The first group included characteristics that are primarily measures of skeletal size and presumably would be less influenced than the characteristics in the second group by such variations in environment as would normally occur.

A report on Canadian Holsteins showed phenotypic correlations between final rating and each type component as follows: general appearance, 0.822; dairy character, 0.499; body capacity, 0.334; mammary system, 0.794; fore udder, 0.665; rear udder, 0.648; legs and feet, 0.438; and rump, 0.503 (32).

Skeletal characteristics are influenced much less than are the production and condition characteristics by changes in the environment. This fact should be taken into consideration when analyzing animals from different herds or from different environmental surroundings. Also, an evaluation of the conformation of animals in various stages of lactation is more apt to be accurate if a greater amount of emphasis is placed on the skeletal characteristics and less on the flesh characteristics or overall body condition.

Rate of Growth of Various Body Parts

There is evidence that dairy cattle do not grow symmetrically even when under continuous good nutrition and management. Studies at Beltsville show how various dimensions at successive ages compare with the same dimensions at maturity. At three months of age the average percentages of maturity for Holsteins were: height, 65; head length, 56; body length, 52; body depth and body circumference, 50; and body width, 45. At first lactation these percentages were within the range of 92 to 98. Percentages for Jerseys were similar (38). Maximum growth is reached between the seventieth and eighty-fourth months (7).

Head length has sometimes been considered a basic measurement in studies of body proportions. In Holsteins at Beltsville the ratio of height at withers to head length decreased from 2.81 at three months to 2.51 at maturity (-11%). By contrast, width of paunch increased from 1.03 to 1.29 (+25%), width of hips, 0.75 to 1.04 (+39%), and width of pinbones, 0.53 to 0.71 (+34%) (38).

Other body proportions also change with age. Legginess, the percentage of total height at withers located below the chest floor, decreased rather steadily from 56.5 at three months of age to 45.2 at maturity. Slope of rump increased from 3.4 to 7.4 degrees, while the ratio of length to width of head increased from 2.4 to 2.9 during the same period of time (38).

According to Blackmore *et al.* (4), phenotypic correlations between characters on the same animal change with age. The correlations at six months and at one year are consistently higher than those at two years. However, the correlations involving one skeletal and one flesh

character change more than the correlations involving two skeletal or two flesh characters. Where a character is affected by both skeletal and flesh factors, the changes are intermediate.

In the same study it was found that genetic correlations also increase with age when two measures from the same group are involved (skeletal or flesh characters), and decrease when one member from each group is involved.

The evidence from these two sources indicates that the effect of general factors is more evident in early growth, whereas later growth shows larger effects of group and specific factors. This evidence of the increasing influence of genes with group and special effects in later development may partly explain the limited accuracy of predicting the type of a cow from its conformation as a calf.

The data on average percentages of maturity of measurements at three months of age will, however, offer a suggestion as to the general body type of the mature animal. For instance, since the three month old calf already has approximately 65 percent of its height, we could not ordinarily expect a short bodied, low set calf to change its conformation enough to make a tall, stretchy cow.

Transmission of Certain Components of Type

Shape of Skull

Very little work has been done regarding the genetics of head characters in cattle. However, among persons familiar with dairy cattle type, the head characteristics are often so pronounced that daughters of a particular bull or cow can be easily picked out from a group on that

basis. Studies indicate that the long narrow head is dominant to the short wide head (10).

Feet and Legs

Among the major dairy breeds the Brown Swiss are generally conceded to have the straightest legs. Sickle hocks, or metatarsal inclination, seems to be affected by multiple genes, some of which may be dominant (10).

Rump

According to Gilmore (10), each of the rump characteristics such as length, width, neatness of tail setting, width and fullness of thurls, levelness from hip bones to pin bones, etc., is presumably governed by different genes.

Udder

Inheritance is believed to play a rather large part in determining udder size, shape, and quality. Supernumerary teats posterior to the normal teats are believed to be the result of a dominant autosomal gene. Marked differences between the daughters of different sires have been observed and breed differences in the frequency of supernumerary teats have also been shown (10).

Hybridization

Crosses between animals of different strains within a breed and those between breeds or species differ only in degree. The fundamental difference lies in the dissimilarity of the genes they introduce to the new aggregate (20).

Hybrids intermediate in one character will tend to be intermediate in others. Hybrids which are most like either parent in one character will tend to resemble that parent in all other characters. When well-differentiated entities hybridize, their cohesive forces continue to operate for many successive generations in hybrid swarms. One may expect to find the characters that went into the cross together, still tending to stay together for scores and perhaps even for hundreds of generations. By a precise and detailed examination of such populations, the cohesive centers of variation still existing within them may be discovered (2).

Linkage

Linkage is an ever-present force because all known germ plasms are made up of long chainlike proteins. Linkage begins to operate whenever the gene differences between two strains become three or more in any chromosome region that ordinarily has only one chiasma.

Examples of genetic linkage have been cited in maize (25), the tomato (24), and in mice (13). In each of these studies a quantitative character was found to be linked with a qualitative character, thus establishing genetic similarity between the factors studied.

When two species hybridize, strong cohesive forces within the germplasm exert their influence at every reduction division. Even in those organisms with the largest numbers of chromosomes, the most chiasmata, and the least localized chiasmata, the hypothetical extreme of complete linkage is more closely approached than is the other extreme of no linkage (2).

The conclusion has been drawn by Anderson (2) that the cohesive force of linkage would be more apparent in the F_3 and succeeding generations than they had been in the F_2. The restriction upon types of recombinations would persist and would be joined by the effect of linkage upon frequencies. With a combination of these influences it is unlikely that the recombinations of the F_3 and subsequent generations could advance much outside the recombination of the F_2. Although this conclusion is based on theory, it is in accord with practical experience (2).

In selection for such epistatic effects as when the intermediate is more desirable than either extreme, linkage may play an active part in keeping the percentage of desired offspring higher than it would be otherwise (26).

Pleiotropy

Pleiotropic genes are those with manifold effects or those which recognizably alter two or more characters of an organism. Genes produce not characters but physiological states which in turn react with the physiological states induced by all other genes of the organism and with the environmental influences. These factors together cause the individual to display certain characters at a given stage of the developmental process (8).

Most of the genes which cause differences in the productive characters of farm animals exert their effects through the transformation and use of food energy. Many of these genes have manifold effects since enhancing the expression of one such character will tend automatically to reduce the expression of another (15).

Physiological Body Balance

The best adapted individuals in a population are those which exhibit a harmonious combination of all characters leading to maximum fitness. Natural selection will then tend to favor either organisms clustering around mean values for all characters, or those in which extreme deviations for one trait are compensated for by some form of deviation in another. Self-regulation of populations, genetic homeostasis, is based on natural selection favoring intermediate rather than extreme phenotypes (23).

In an example cited by Graves and Fohrman (12), approximately 75 percent of a bull's daughters in two herds were high producing cows and the remaining 25 percent were very mediocre producers. A question was raised as to whether these poor daughters were low because they had received an inheritance for low production from their parents or because of some physiological weakness that made it impossible for them to express what was believed to be their inherited capacity. Through experimentation it was discovered that the poor producing daughters of this particular sire were probably low producers because of a deficiency in the secretion of some necessary principle from the anterior pituitary.

It is probable that physiologically complicated characteristics such as milk production, health, vigor, fertility, etc., are dependent for their maximum expression on a harmonious balancing of the magnitudes and functions of many different organs (15,26). It is reasonable to assume then that in selecting for the maximum level in these economically important characteristics the breeder is actually selecting for

balanced or intermediate sizes of lungs, heart, digestive tract, etc. (26).

It has been hypothesized that multiple additive genes are either plus or minus. Any parent may have all plus pairs, all minus pairs, or a combination of some plus and some minus genes paired. The genes from each parent undergo reduction division and then become paired again in the zygote and balanced at a point related to the numerical strength of either kind of gene. That balance controls the phenotype of the offspring (20).

Selection for an intermediate is not necessarily selection for heterozygosis. Intermediacy and heterozygosis are almost unrelated to each other, provided the characteristic is affected by more than two or three pairs of genes (26).

Compensatory Matings

Compensatory matings, or negative assortive mating on the basis of somatic resemblance, are used to correct defects by mating each animal to one which is equally extreme but in the opposite direction. This type of mating system is most useful when the desired type is an intermediate. Mating unlikes together tends to make the whole population uniform since an extreme individual in one direction would tend to be mated with one which is equally extreme in the other direction. Most of this increase in uniformity would occur in the first generation. An outcross to a relatively unrelated stock having some desirable characteristics which are absent or rare in the breeder's own herd may restore genetic variability.

The corrective mating should be made to correct some definite defect in a herd or strain. According to Winters (46), the outcross needs to be followed by a certain amount of inbreeding so that it won't be lost in subsequent outcrossings.

EXPERIMENTAL PROCEDURE

Two surveys involving three different questionnaires were used in this study. In the first survey, two questionnaires were sent to breeders of registered Holstein-Friesian dairy cattle. The breeders that indicated on the first questionnaire that they were willing to cooperate in a more extensive study were sent the detailed second questionnaire.

The second survey consisted of a questionnaire sent to all artificial insemination associations in the United States.

Survey of Breeders of Registered Holsteins

First Questionnaire

A list of every breeder of registered Holstein cattle whose herd was on H.I.R. test and had been analyzed prior to January 1, 1958 was obtained from W. A. Weeks of a.A.a. Thirty-four different states were represented in this group. After exclusion of herds no longer in operation and those that hadn't been analyzed by the present system, a total of 283 herds remained.

Each breeder on this list was sent a copy of the first questionnaire. This two page questionnaire and the letter that accompanied it may be found in Appendix II. Several months after the first questionnaire was sent, another copy of the same questionnaire was sent to those who hadn't responded. The letter which accompanied this questionnaire may also be found in Appendix II.

The first page of this questionnaire contained questions of a general nature to determine how well the a.A.a. system has been accepted by

the breeders, and whether or not the breeders believe the a.A.a. system is concrete enough to be learned. Opinions, comments, and suggestions for study of the a.A.a. system were also solicited.

The second page was the result of an attempt to determine the matings that produce the cows with very good type and production and also the matings that produce the cows with poor type and production. The cows with very good type and production were those that officially classified Very Good or Excellent and produced 600 pounds or more butterfat in a year, actual production. This group is hereafter referred to as the Very Good - 600 pound cows. The cows considered to have poor type and production were those that officially classified Fair or Poor and produced less than 400 pounds of butterfat in a year, actual production.

In an attempt to increase the percentage of response to the question on whether or not the a.A.a. system has merit, a self-addressed stamped postcard and an accompanying letter were sent to the breeders who had failed to respond to the questionnaire. This card and letter may be found in Appendix II.

Second Questionnaire

All breeders that indicated, on the first questionnaire a willingness to cooperate in a more extensive study were sent a second, detailed questionnaire. This questionnaire and its accompanying letter may be found in Appendix II.

In this detailed questionnaire an attempt was made to determine whether or not the herds are changing in conformation according to analysis data. The breeders' viewpoints on body balance were also desired. Three

pages of this questionnaire were devoted to a study of the relationships among form, function, and type of mating. Twenty-two different factors were included in this part of the study. Each of them was suspected of being influenced in some way either by the analysis of the animal, or by the type of mating that produced the animal.

Survey of Artificial Insemination Associations

A questionnaire was sent to each artificial insemination association in the continental United States that was a 1959 member of the National Association of Artificial Breeders. There were 63 associations in this group. A copy of this questionnaire and the letter which accompanied it are found in Appendix III. Approximately one month after the questionnaire was sent, a follow-up letter was mailed to the associations that had not responded. This follow-up letter may also be found in Appendix III.

The first page of the questionnaire consisted of general questions to determine how widespread the use of the a.A.a. system has been among the associations and how much interest in this system there has been among the patrons.

The second page of the questionnaire provided space for specific information on analyzed bulls in artificial service.

Statistical Procedure

Due to the nature of the problem and the source of the data it was impossible to obtain a control population for this study. Therefore it was necessary that an expected group of values be determined to provide a

basis for comparison with the actual values derived from the data.

The percentage of the analyzed Holstein population in each analysis category was used to determine the expected number of animals for that category. These percentages were obtained from W. A. Weeks (41) of Animal Analysis Associates. As an example, 26 percent of the cows in the Holstein breed are SSR's. Therefore, in a population of 114 animals the expected number of SSR's would be 26 percent of 114 or 29.6.

In determining the expected values for each type of mating (No. 1, 3/3, 4/2, etc.) the percentage figures obtained from W. A. Weeks for all Holstein cows and for all Holstein bulls were used. The frequency of each type of mating was calculated by multiplying all of the percentage figures for the bulls by all of the percentage figures for the cows and then grouping the results according to type of mating.

The actual numbers of animals and matings were compared with these expected values by means of the chi-square (χ^2) test. This made it possible to determine whether the population under study differed from an expected or random group of animals or matings.

RESULTS

The results obtained in this study are presented in the same order and under the same headings as given in the survey procedure. All questionnaires used may be found in Appendix II and Appendix III. It should be recognized that the numbers of cows in some cases are small because of the limited, available data and limited response to the second questionnaire.

Survey of Breeders of Registered Holsteins

First Questionnaire

The breeders' replies to the general questions on analyzing are summarized in Table I. The total percentage response is given and the number and percentage of those that responded are given for each reply to the questions. A representative sample of the comments from these breeders may be found in Appendix IV.

The analyses of 351 Very Good - 600 pound cows were obtained. These data are presented in Table II. Both of the analysis categories having R-front and S-rear characters showed highly significant increases in actual over the expected numbers. None of the other deviations from expected were significant.

Data on the matings that produced the Very Good - 600 pound cows were obtained for 132 cows. These are shown in Table III. Although the only chi-square value showing significance is the one for the No. 1 matings, a general trend may be noted in the last column where the difference is expressed as a percentage of the expected number. These figures

TABLE I. BREEDERS' REPLIES TO THE QUESTIONS ON THE FIRST QUESTIONNAIRE

1. Do you think that analyzing has merit as a tool in the breeding of better dairy cattle?

Results - 78.6% of those receiving the questionnaire replied to this question.

	Number	Percent
yes -	159	71.3
no -	23	10.3
? -	41	18.3

2. Do you believe that any good cow man could learn to analyze?

Results - 52.5% of those receiving the questionnaire replied to this question.

yes -	99	66.4
no -	19	12.7
? -	31	20.8

3. Does the analysis information on your herd supplement the classification information, or take the place of it?

Results - 52.5% of those receiving the questionnaire replied to this question.

Supplements it -	100	67.1
Replaces it -	3	2.0
? -	46	30.8

4. Would you be willing to cooperate in a more detailed study involving your entire herd?

Results - 52.5% of those receiving the questionnaire replied to this question.

yes -	103	69.1
no -	12	8.0
? -	34	22.8

5. Would you like a summary at the conclusion of this project?

Results - 52.5% of those receiving the questionnaire replied to this question.

yes -	125	83.8
no -	4	2.6
? -	20	13.4

TABLE II. ANALYSES OF THE VERY GOOD AND EXCELLENT COWS WITH RECORDS OF 600 POUNDS OR MORE BUTTERFAT - ACTUAL PRODUCTION

Analysis	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2 Value[1]
RRR	17	4.8	21.1	6.0	- 4.1	0.796
RRS	19	5.4	7.0	2.0	+ 12.0	20.571**
RSR	22	6.3	28.1	8.0	- 6.1	1.324
SRR	68	19.4	59.7	17.0	+ 8.3	1.154
RSS	24	6.8	14.0	4.0	+ 10.0	7.143**
SRS	44	12.5	52.7	15.0	- 8.7	1.436
SSR	77	21.9	91.3	26.0	- 14.3	2.240
SSS	80	22.8	77.2	22.0	+ 2.8	0.101
Total	351	100.0%	351.0	100.0%	---	34.765**

[1] χ^2 = Chi-square

**Highly significant ($P < 0.01$)

TABLE III. MATINGS THAT PRODUCED THE VERY GOOD AND EXCELLENT COWS WITH RECORDS OF 600 POUNDS OR MORE BUTTERFAT - ACTUAL PRODUCTION

Mating	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2	Difference as a % of expected
No. 1	28	21.2	13.4	10.2	+ 14.6	15.910**	+ 109.0
3/3	33	25.0	25.2	19.1	+ 7.8	2.413	+ 31.0
4/2	49	37.1	60.9	46.1	- 11.9	2.325	- 19.5
5/1	20	15.2	27.2	20.6	- 7.2	1.904	- 26.5
6/0	2	1.5	5.2	3.9	- 3.2	1.962	- 61.5
Total	132	100.0%	132.0	100.0%	---	24.514**	---

**Highly significant ($P<0.01$)

show that the differences (actual minus expected), when put on a comparable basis with each other, give a series of values that decrease directly with a decrease in desirability of the matings.

Data on the cows with poor type and production were too few to permit further comparisons.

Second Questionnaire

One hundred of these questionnaires were sent to the breeders that indicated they would be willing to cooperate in a more detailed study. Nineteen were returned and letters or post cards were received from six of the other breeders about this questionnaire.

Twelve herds that had been analyzed at least twice were used to determine any changes in the analysis of the herds between the first and the last time they had been analyzed. These data are shown in Table IV. A highly significant increase in SRR's and SRS's, a highly significant decrease in RSR's and a significant decrease in RSS's were obtained.

The results of the study of the relationships between form and function are shown in Tables V, VI, VII, VIII, and IX. In these tables the analyses of the animals are synonymous with form, and the title of each table describes the function. All of the functions under question that had less than 30 cows listed were eliminated from this part of the study. The tables for cows that milk faster than their dams and cows that milk out more completely than their dams were practically identical to Table VIII and were therefore not included.

The data presented in these tables show positive relationships between the RRS analysis and very aggressive feeders; between the RRR analysis

TABLE IV. A COMPARISON BETWEEN THE FIRST ANALYSIS AND THE LATEST ANALYSIS OF TWELVE PUREBRED HOLSTEIN-FRIESIAN HERDS

NUMBER OF COWS IN EACH CATEGORY - FIRST ANALYSIS - 1955

Herd no.	RRR	RRS	RSR	SRR	RSS	SRS	SSR	SSS
257	5	4	14	8	3	8	9	14
147	5	5	2	13	1	6	9	6
237	2	0	7	2	3	1	14	10
96	0	0	1	3	0	4	10	22
115	5	2	4	5	10	3	6	4
297	0	0	1	1	3	0	6	9
80	6	1	7	4	5	3	9	8
337	0	1	1	7	1	4	12	9
174	11	15	5	11	13	6	17	21
290	3	1	3	5	0	6	16	9
307	1	1	4	4	5	3	7	3
341	1	0	2	6	3	2	18	6
Total	39	30	51	69	47	46	133	121
Percent	7.3	5.6	9.5	12.9	8.8	8.6	24.8	22.6

NUMBER OF COWS IN EACH CATEGORY - LATEST ANALYSIS - 1959

Herd no.	RRR	RRS	RSR	SRR	RSS	SRS	SSR	SSS
257	4	2	7	12	5	12	13	7
147	5	5	3	16	1	2	13	18
237	1	0	2	2	3	6	10	8
96	0	0	2	5	1	8	7	18
115	4	1	4	12	4	2	5	8
297	0	3	2	7	3	9	9	5
80	4	2	3	18	3	10	9	9
337	4	0	1	9	5	5	9	11
174	7	11	4	18	2	17	27	14
290	3	2	1	14	0	12	10	11
307	4	1	4	3	4	0	7	5
341	0	0	1	7	5	3	10	7
Total	36	27	34	123	36	86	129	121
Percent	6.1	4.6	5.7	20.8	6.1	14.5	21.8	20.4
χ^2 =	1.199	1.157	8.769	28.424	4.975	24.204	2.158	1.224
Incr. or Decrease	-	-	-	+	+	+	-	-
Significance			**	**	*	**		

*Significant ($P<0.05$)

**Highly significant ($P<0.01$)

TABLE V. ANALYSES OF THE COWS THAT ARE VERY AGRESSIVE FEEDERS

Analysis	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2 Value
RRR	5	6.8	4.4	6.0	+ 0.6	0.082
RRS	10	13.7	1.5	2.0	+ 8.5	48.167**
RSR	5	6.8	5.8	8.0	- 0.8	0.110
SRR	14	19.2	12.4	17.0	+ 1.6	0.206
RSS	5	6.8	2.9	4.0	+ 2.1	1.521
SRS	11	15.1	11.0	15.0	0	0
SSR	12	16.4	19.0	26.0	- 7.0	2.579
SSS	11	15.1	16.1	22.0	- 5.1	1.616
Total	73	100.0%	73.0	100.0%	--	54.281**

**Highly significant ($P < 0.01$)

TABLE VI. ANALYSES OF THE COWS THAT ARE NERVOUS OR "HIGH STRUNG"

Analysis	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2 Value
RRR	5	14.7	2.0	6.0	+ 3.0	4.500*
RRS	2	5.9	0.7	2.0	+ 1.3	2.414
RSR	1	2.9	2.7	8.0	- 1.7	1.070
SRR	9	26.5	5.8	17.0	+ 3.2	1.766
RSS	0	0	1.4	4.0	- 1.4	1.400
SRS	7	20.6	5.1	15.0	+ 1.9	0.708
SSR	6	17.6	8.8	26.0	- 2.8	0.891
SSS	4	11.8	7.5	22.0	- 3.5	1.633
Total	34	100.0%	34.0	100.0%	--	14.382*

*Significant ($P < 0.05$)

TABLE VII. ANALYSES OF FEMALES SOLD FOR BEEF OR BUTCHERED FOR REASONS OTHER THAN OLD AGE

Analysis	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2 Value
RRR	6	6.8	5.3	6.0	+ 0.7	0.092
RRS	6	6.8	1.8	2.0	+ 4.2	9.800**
RSR	2	2.3	7.0	8.0	- 5.0	3.571
SRR	18	20.5	15.0	17.0	+ 3.0	0.600
RSS	9	10.2	3.5	4.0	+ 5.5	8.643**
SRS	9	10.2	13.2	15.0	- 4.2	1.336
SSR	20	22.7	22.9	26.0	- 2.9	0.367
SSS	18	20.5	19.4	22.0	- 1.4	0.101
Total	88	100.0%	88.0	100.0%	--	24.510**

**Highly significant ($P < 0.01$)

TABLE VIII. ANALYSES OF COWS THAT MILK OUT FAST - (LESS THAN FOUR MINUTES)

Analysis	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2 Value
RRR	7	6.1	6.8	6.0	+ 0.2	0.006
RRS	10	8.8	2.3	2.0	+ 7.7	25.778**
RSR	7	6.1	9.1	8.0	- 2.1	0.485
SRR	24	21.1	19.4	17.0	+ 4.6	1.091
RSS	4	3.5	4.6	4.0	- 0.6	0.078
SRS	25	21.9	17.1	15.0	+ 7.9	3.650
SSR	20	17.5	29.6	26.0	- 9.6	3.114
SSS	17	14.9	25.1	22.0	- 8.1	2.614
Total	114	100.0%	114.0	100.0%	--	36.816**

**Highly significant ($P < 0.01$)

TABLE IX. ANALYSES OF COWS THAT MILK OUT SLOW - (MORE THAN SIX MINUTES)

Analysis	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2 Value
RRR	2	5.0	2.4	6.0	- 0.4	0.067
RRS	1	2.5	0.8	2.0	+ 0.2	0.050
RSR	8	20.0	3.2	8.0	+ 4.8	7.200**
SRR	9	22.5	6.8	17.0	+ 2.2	0.712
RSS	4	10.0	1.6	4.0	+ 2.4	3.600
SRS	2	5.0	6.0	15.0	- 4.0	2.667
SSR	14	35.0	10.4	26.0	+ 3.6	1.246
SSS	0	0	8.8	22.0	- 8.8	8.800**
Total	40	100.0%	40.0	100.0%	--	24.342**

**Highly significant ($P < 0.01$)

and being nervous or "high strung"; and between both analyses with R-front, S-rear character and cull females.

Although only one analysis category showed significance in the group of cows that milk out fast (Table VIII), it should be noted that all four analyses with R-udder character showed a positive association while all four of the analyses with S-udder characters showed a negative association.

Three of the four S-udder analyses showed a positive relationship in the group of cows that milk out slowly. The SSS cows however show a highly significant negative relationship.

Tables X, XI, XII, XIII, XIV, and XV show the associations between the type of mating and the various functions. In this part of the study all functions under question that had less than 20 cows listed were eliminated. The tables for cows that milk faster than their dams and cows that milk out more completely than their dams were practically identical to Table XII and were therefore not included here.

Significant positive associations were found between No. 1 matings and aggressive feeders; between No. 1 matings and cows that milk out fast; and between 6/0 matings and calves that died after birth. Significant negative associations were found between 3/3 matings and cows that milk out fast and between 5/1 matings and cows that milk out fast.

TABLE X. MATINGS THAT PRODUCED THE COWS THAT ARE VERY AGGRESSIVE FEEDERS

Mating	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2	Difference as a % of expected
No. 1	18	36.7	5.0	10.2	+ 13.0	33.800**	+ 260.0
3/3	7	14.3	9.4	19.1	- 2.4	0.612	- 25.5
4/2	18	36.7	22.6	46.1	- 4.6	0.936	- 20.4
5/1	5	10.2	10.1	20.6	- 5.1	2.575	- 50.5
6/0	1	2.0	1.9	3.9	- 0.9	0.426	- 47.4
Total	49	100.0%	49.0	100.0%	--	38.349**	--

**Highly significant ($P<0.01$)

TABLE XI. MATINGS THAT PRODUCED FEMALES SOLD FOR BEEF OR BUTCHERED FOR REASONS OTHER THAN OLD AGE

Mating	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2	Difference as a % of expected
No. 1	2	6.3	3.3	10.2	- 1.3	0.512	- 39.4
3/3	8	25.0	6.1	19.1	+ 1.9	0.592	+ 31.1
4/2	17	53.1	14.8	46.1	+ 2.2	0.327	+ 14.9
5/1	4	12.5	6.6	20.6	- 2.6	1.024	- 39.4
6/0	1	3.1	1.2	3.9	- 0.2	0.033	- 16.7
Total	32	100.0%	32.0	100.0%	--	2.491	--

TABLE XII. MATINGS THAT PRODUCED COWS THAT MILK OUT FAST - (LESS THAN FOUR MINUTES)

Mating	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2	Difference as a % of expected
No. 1	25	26.6	9.6	10.2	+ 15.4	24.704**	+ 160.4
3/3	9	9.6	18.0	19.1	- 9.0	4.500*	- 50.0
4/2	48	51.1	43.3	46.1	+ 4.7	0.510	+ 10.9
5/1	10	10.6	19.4	20.6	- 9.4	4.555*	- 48.5
6/0	2	2.1	3.7	3.9	- 1.7	0.781	- 45.9
Total	94	100.0%	94.0	100.0%	--	35.050**	--

*Significant ($P < 0.05$)

**Highly significant ($P < 0.01$)

TABLE XIII. MATINGS THAT PRODUCED COWS THAT MILK OUT SLOW - (MORE THAN SIX MINUTES)

Mating	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2	Difference as a % of expected
No. 1	2	10.0	2.0	10.2	0	0	0
3/3	7	35.0	3.8	19.1	+ 3.2	2.695	+ 84.2
4/2	6	30.0	9.2	46.1	- 3.2	1.113	- 34.8
5/1	5	25.0	4.1	20.6	+ 0.9	0.198	+ 22.0
6/0	0	0	0.8	3.9	- 0.8	0.800	-100.0
Total	20	100.0%	20.0	100.0%	--	4.806	--

TABLE XIV. MATINGS THAT PRODUCED CALVES THAT WERE BORN DEAD

Mating	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2	Difference as a % of expected
No. 1	6	18.2	3.4	10.2	+ 2.6	1.988	+ 76.5
3/3	3	9.1	6.3	19.1	- 3.3	1.729	- 52.4
4/2	13	39.4	15.2	46.1	- 2.2	0.318	- 14.5
5/1	9	27.3	6.8	20.6	+ 2.2	0.712	+ 32.4
6/0	2	6.1	1.3	3.9	+ 0.7	0.377	+ 53.8
Total	33	100.0%	33.0	100.0%	--	5.124	--

TABLE XV. MATINGS THAT PRODUCED CALVES THAT DIED AFTER BIRTH

Mating	Actual no. of cows	Actual percent	Expected no. of cows	Expected percent	Difference act. - exp.	χ^2	Difference as a % of expected
No. 1	2	8.0	2.6	10.2	- 0.6	0.138	- 23.1
3/3	3	12.0	4.8	19.1	- 1.8	0.675	- 37.5
4/2	12	48.0	11.5	46.1	+ 0.5	0.022	+ 4.3
5/1	4	16.0	5.2	20.6	- 1.2	0.277	- 23.1
6/0	4	16.0	1.0	3.9	+ 3.0	9.000**	+300.0
Total	25	100.0%	25.0	100.0%	--	10.112*	--

*Significant ($P < 0.05$)

**Highly significant ($P < 0.01$)

Survey of Artificial Insemination Associations

Table XVI contains a summary of the replies to the general questions about the a.A.a. system by the artificial insemination associations. The total percentage response is given, and the number and percentage of those that responded are given for each reply to the questions. A representative sample of the comments from these associations may be found in Appendix IV.

The analyses of the analyzed bulls in artificial service throughout the United States are given in Table XVII for each of the more popular bloodlines. The totals show the analyses of all analyzed sires in artificial service. These data for all bulls together were compared, along with the data for the Burke and Carnation-Homestead bloodlines, with the data obtained previously from W. A. Weeks. This comparison between the two studies may be found in Table XX, Appendix I.

Insufficient data were available for determination of the relationships among analysis, body weight, and classification of the bulls.

TABLE XVI. REPLIES TO QUESTIONNAIRE BY ARTIFICIAL INSEMINATION ASSOCIATIONS

1. Have any of your bulls been a.A.a. analyzed?

Results - 95.2% of the associations responded to this question.

	Number	Percent
yes -	30	50.0
no -	30	50.0

2. Do you publish the analysis information on your bulls in your literature?

Results - 90.0% of the associations that have been analyzed responded to this question.

yes -	19	70.4
no -	8	29.6

3. What is your impression of patron interest in the a.A.a. analysis of your bulls?

Results - 71.4% of the associations sent to responded to this question.

No interest -	5	11.1
Very little -	21	46.7
Some interest -	13	28.9
Much interest -	6	13.3

4. Do you believe that the a.A.a. program could help the artificial breeding industry by providing patrons with analysis information on the bulls?

Results - 69.8% of the associations responded to this question.

Harmful -	1	2.3
No help -	11	25.0
Questionable -	12	27.3
Possibly some -	9	20.5
Yes -	11	25.0

5. Approximately what percent of your patrons breed according to a.A.a. recommendations?

Results - 68.3% of the associations responded to this question.

None -	14	32.6
Less than 1% -	23	53.5
1% to 25% -	4	9.3
? -	2	4.7

TABLE XVII. ANALYSES OF ANALYZED BULLS IN ARTIFICIAL SERVICE IN THE UNITED STATES BY BLOODLINE - 1959

Bloodline	No. of bulls	Percent		SSS	SSR	SRS	RSS	SRR	RSR	RRS	RRR
Burke	79	21.9	No.	- 3	11	9	3	25	3	10	15
			%	- 3.8	13.9	11.4	3.8	31.6	3.8	12.7	19.0
Rag Apple	63	17.5	No.	- 8	12	9	7	15	2	6	4
			%	-12.7	19.0	14.3	11.1	23.8	3.2	9.5	6.3
Carnation & Homestead	41	11.4	No.	- 5	13	1	5	6	8	0	3
				12.2	31.7	2.4	12.2	14.6	19.5	0	7.3
Ormsby	31	8.6	No.	- 6	5	1	0	5	3	2	9
			%	-19.4	16.1	3.2	0	16.1	9.7	6.5	29.0
Dunloggin	31	8.6	No.	- 6	6	3	1	7	4	0	4
			%	-19.4	19.4	9.7	3.2	22.6	12.9	0	12.9
(not identified)	77	21.3	No.	-17	13	11	4	8	11	4	9
			%	-22.1	16.9	14.3	5.2	10.4	14.3	5.2	11.7
Outbreds	21	5.8	No.	- 4	4	4	1	2	6	0	0
			%	-19.0	19.0	19.0	4.8	9.5	28.6	0	0
Misc. Bloodlines	18	5.0	No.	- 2	1	2	1	3	1	3	5
			%	-11.1	5.6	11.1	5.6	16.7	5.6	16.7	27.8
Totals	361	100.0	No.	-51	65	40	22	71	38	25	49
			%	-14.1	18.0	11.1	6.1	19.7	10.5	6.9	13.6

DISCUSSION OF RESULTS

The a.A.a. system seems to be quite well accepted by the breeders that cooperated in this study as shown by the first questionnaire. It is impossible to ascertain what the exact results would have been had a 100 percent response been obtained. However, the results obtained from the last mailing (the self-addressed postcard) showed only a slight decrease in the percent that favorably accept the a.A.a. system.

A large percentage of the cooperating breeders believe the a.A.a. system can be learned by anyone familiar with dairy cattle type. In an attempt to obtain further information on this subject, a separate experiment was carried out on the South Dakota State College dairy cattle. This experiment is explained and summarized in Table XIX, Appendix I. From this experiment it appears that the udder may be the most difficult part of the animal to analyze. The fact that all three of the men averaged 67 or 70 percent in their analyses strongly suggests that the a.A.a. system can be learned. Certain cows appear to be easier to analyze than others, and the greatest amount of error naturally occurs on cows that are very close to the borderline between R and S for one or more of the three body divisions.

One question that often arises when discussing the a.A.a. system is that of its relationship to the breed sponsored classification program. Some people have feared that the breeders would attempt to use this system as a substitution for classification. It was found, however, that only three of the cooperating breeders are using analysis as a substitution for classification, and one or two of these mentioned that they

realize the difference between the two programs and plan to use both in the future. It strongly appears that no conflict between the use of the analysis and classification programs exists as far as the breeders that cooperated with this study are concerned.

The larger numbers of Very Good - 600 pound cows than expected in the R-front, S-rear analyses is rather difficult to explain. One explanation which has been offered but which would be difficult to prove is that since these two analyses are in the minority in both the cow and bull populations, the animals possessing these analyses would probably not be extremes in their R or S characters. They would therefore have a better chance of classifying higher and producing more. In accepting this explanation one would also be accepting several other unproven and controversial theories relating to inheritance of R and S characters and relationship of the degree of roundness or sharpness to production and classification. For these reasons this explanation cannot yet be fully accepted.

It was hoped that a determination of the matings that produce the Very Good - 600 pound cows would shed some light on the merits of the a.A.a. system. Although these data are necessarily not sufficient for conclusively proving a system of mating, the type of mating does appear to have a positive effect on the frequency of occurrence of Very Good - 600 pound cows.

The time lapse between the time the present a.A.a. system was devised and the time these data were collected was not sufficient to allow the breeders to make a large number of No. 1 and 3/3 matings and thereby influence this study. The possibility exists however that breeders unknowingly make more No. 1 and 3/3 matings and less 5/1 and 6/0 matings either through chance or through their own use of compensatory matings. It does

not seem that this fact alone could account for the results obtained in this part of the study, however.

It has been suspected that the number of SRR animals is increasing while the number of RSS animals is decreasing. This study offers data to support this belief and it also shows an increase in SRS animals and a decrease in RSR's. The reasons for these changes are unknown although it is believed that S-front and R-uddered animals are favored in the showring, and all but two of the herds in this part of the study do some showing at the fairs.

The theory that the R-front-ended animals are more aggressive feeders is supported to a certain extent by this study, however only one chi-square value was large enough for significance. Characteristics of an R-front end, such as a wide muzzle or a wide chest floor, may also be characteristics found in aggressive feeders.

The highly significant chi-square values for No. 1 matings in the tables for aggressive feeders and fast milkers are more meaningful when compared to the low chi-square values for cull females, slow milkers, and matings that produced dead calves. This fact would tend to eliminate the possibility that the entire population under study was the result of an excessively large number of No. 1 matings.

The evidence presented here, although not conclusive due to insufficient numbers in some cases and the lack of a definite control population for comparisons, seems to indicate a positive relationship between the desirable matings of the a.A.a. system and certain of the desirable characteristics which were studied. The a.A.a. system appears to have merit when breeding for these characteristics.

It does not seem feasible at this time to carry out a controlled breeding experiment to further determine the merits of the a.A.a. system. Not only would a large duration of time and a great deal of expense be necessary, but also, one or two experimental herds probably could not give sufficient numbers for a definite proof of the system. It appears that further use of the herds that have been using the system for several years may be desirable. In a study of this kind, records should be available to cover every mating made in the herd regardless of outcome. In this way one would have an exact measure of the numbers of each type of mating that had been made.

Since dairy cattle vary greatly in their degree of roundness or sharpness, it seems that some method of designating the degree would be very worthwhile. This has been suggested by many breeders and is being contemplated by a.A.a. at the present time.

It should be pointed out here that this system is difficult for many people to comprehend. This appears especially true of those who either have not observed a large number of dairy cattle or those who have pre-established, fixed ideas on type and its improvement. To those who have carefully observed dairy cattle type, certain body characteristics appear to be associated with one another. Further research would be required to determine whether or not these characteristics which are grouped into a letter designation in the a.A.a. system are highly correlated.

At the present time the a.A.a. system appears to have merit as a tool in the breeding of better dairy cattle. It should be remembered,

however, that the maximum amount of progress is obtained only through using the tool in its proper perspective along with the other tools available.

SUMMARY

Two surveys were conducted in this study, one involving breeders of registered Holstein-Friesian cattle, and the second involving the artificial insemination associations. A summary of the major findings is as follows:

1. The a.A.a. system seems to be quite well accepted by the breeders that have cooperated in this study.
2. The a.A.a. system can be learned, and a person well familiarized with dairy type can learn to analyze cattle with a moderate degree of accuracy.
3. This study indicated that breeders who answered the questionnaire seem to realize the difference between analysis and the classification program since only a few use analysis as a substitution for classification.
4. A larger number than expected of the Very Good - 600 pound cows were found in the R-front end, S-rear end analyses. The reason for this is not known at this time.
5. A significantly larger number than expected of the Very Good - 600 pound cows in this study were produced by No. 1 matings. Decreases in comparable numbers of Very Good - 600 pound cows occurred with decreasing desirability of the matings though these differences were not great enough for significance.
6. The relative numbers of SRR and SRS animals have increased at the expense of the RSS and RSR groups in the herds used for this part of the study.

7. Significantly larger numbers than expected of aggressive feeders and fast milkers were the result of No. 1 matings.
8. A controlled breeding experiment to further determine the merits of the a.A.a. system would probably not be practical at the present time. Further research making use of data from herds that have been using the system for several years would seem desirable.
9. Refinement of the a.A.a. system to include degree of roundness or sharpness may be desirable to improve accuracy when selecting unlike mates.
10. The a.A.a. system seems to have merit in the breeding of better dairy cattle, and although it cannot yet be considered conclusively proven, certainly the concept of correcting deficiencies by compensatory matings appears logical.

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APPENDICES

APPENDIX I.

TABLE XVIII. ROUND AND SHARP CHARACTERISTICS

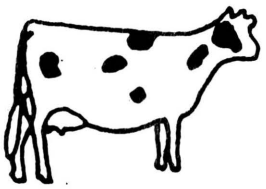
		R	S
	GENERAL APPEARANCE		
Breed Characteristics			
	Color	White Grey	Black Rust
	Size	Short legs	Weakness
Head			
	Ears	Short & broad	Long & narrow
	Eyes	Small	Large
Shoulder Blades		Smooth	Loose or winged
Back		Weak	Strong
Loin	Side - Rear -	Weak Wide & level	Strong Narrow & slopes to side
Rump		Long & narrow	Short & wide
	Sacrum	Level	High or arched
	Loin to Tailhead	Level	Rough or arched
	Tail setting	High	Neat
	Thurls	Narrow & low	High
	Pin Bones	Narrow	Wide
	Tailhead	High, forward	Neat, back
	Tail	Short	Long

TABLE XVIII. (continued)

	R	S
Legs and Feet	Short	Long
	Coarse	Clean cut
	Round bone	Flat bone
From side -	Straight	Offset
From rear -	Cow hocked	Straight
Pasterns	Long(weak)	Short(strong)
Feet		
Front	Round	Long
Heel	Shallow	Deep
Hocks	Puffy	Clean cut
	Cow hocked	Straight
Front Legs		
Front or side	Straight	Crooked
Hide and Hair		
Skin	Loose & pliable	Thin
Hair	Coarse	Fine
	Curly	Straight
	MAMMARY SYSTEM	
Udder	Forward	Back
	Long	Short
	Neaty	Quality
Veins on udder -	Prominent	Do not appear
	Pink	White
	Wide	Narrow
Attachments	Low-wide	High-narrow
Teats	Small	Larger in front
	Squarely placed	Wide in front
	Cylindrical	Conical
	Extra (4 plus)	No extra
	BULLS	
Testicles	Like apples	Like pears
	Forward	Back
	Even	Uneven
	High	Low

TABLE XVIII. (continued)

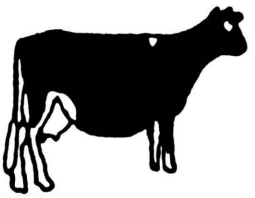
	R	S
Rudimentaries	Small	Long
	Uniform size	Front longer
	Cylindrical	Conical
	4 plus	4 only
	Wide apart & squarely placed	Close with front further out
	Forward	Back
Horns	Refined	Coarse
	MISCELLANEOUS	
	Wry tail	Excess of hair
	Twisted face	Low set ears
	Grey color	Crowded teeth
	Small ears	Snipe nose
	Cross eyes	Narrow face
	Pop eyes	Easy calving
	Poor or bad disposition	
	Pendulous udder - meaty	Pendulous udder - good quality
	Easy milking (blunt tipped)	Hard milking (pointed end)
	Most cystic ovaried cows	
	Crooked tail	



"ROUND" and "SHARP"
Analysis

No._____by **aAa**

Any cow is (R) or (S) in character of front end, udder and rear end-



RRR	RRS	RSR	SRR	RSS	SRS	SSR	SSS

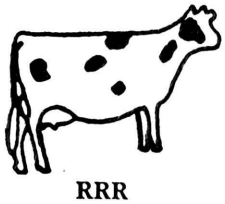
and breeds best with *a good bull* of opposite analysis-

SSS	SSR	SRS	RSS	SRR	RSR	RRS	RRR

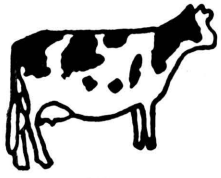
Figure 1. a.A.a. Analysis Card

Analysis HELPS BREED BETTER COWS

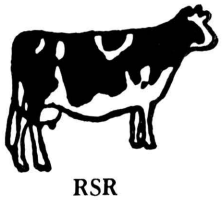
Some dairy cows and bulls produce very good offspring when mated together while others do not. *Analysis* indicates in advance which ones will produce the desired results.



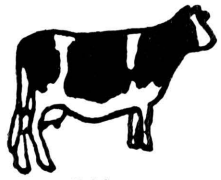
RRR



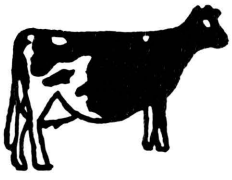
RRS



RSR

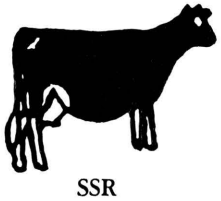


RSS

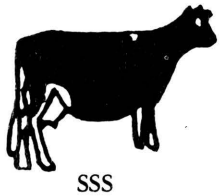


SRR

SRS

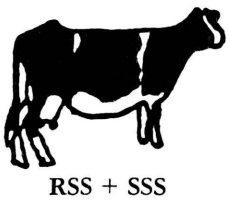


SSR

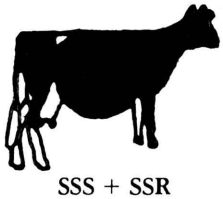


SSS

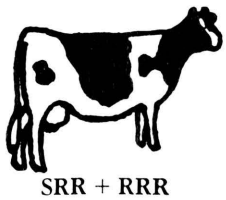
Any dairy cow or bull can be *Analyzed* as one of the above combinations of "Round" and "Sharp" type with variations in (a) front end, (b) udder and (c) rear end.



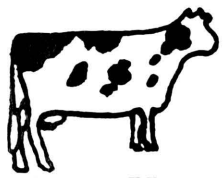
RSS + SSS



SSS + SSR



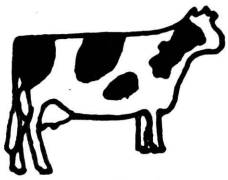
SRR + RRR



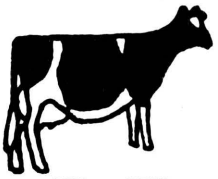
RRS + RRR

Sharp + Sharp breeds narrow, weak offspring like the two above with short udders, crooked legs and sloping rumps; cows that do not stay in the herd very long,

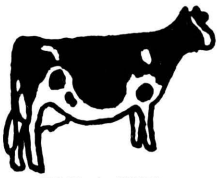
and Round + Round breeds coarse, heavy offspring like these two with meaty udders, stiff legs and rough tail heads; cows that do not produce and reproduce very well,



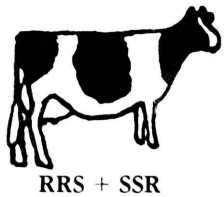
RSS + RRR



SSS + SRR



SRR + RSR



RRS + SSR

but Round + Sharp breeds strong, refined cattle like these with balanced udders, clean-cut legs and level rumps; cows that produce milk heavily and live a long time.

Figure 2. Pictorial Description of the a.A.a. System

TABLE XIX. RESULTS OF ANALYSIS OF THE SOUTH DAKOTA STATE COLLEGE DAIRY HERD BY THREE DIFFERENT MEN COMPARED TO THE OFFICIAL a.A.a. ANALYSIS*

Amount of Experience of the Three Men

No. 1 - Had seen no analysis work done but had studied the system.

No. 2 - Had seen one herd analyzed and had also studied the system.

No. 3 - Had seen several herds analyzed and had studied the system.

Table Showing Percent Correct

	No. of animals	Front end	Udder	Rear end	Average
No. 1 -	77	75.0%	60.0%	64.0%	67.0%
No. 2 -	77	69.0%	62.0%	69.0%	67.0%
No. 3 -	73	73.0%	60.0%	77.0%	70.0%
Ave. -	75.6	72.3%	60.7%	70.0%	68.0%

*The official analysis for this study was made by Mr. William A. Weeks of Rockford, Illinois. No. 1 and No. 2 analyzed the herd two days prior to Mr. Weeks' visit and No. 3 analyzed the herd five months after the official analysis was made. No. 3 had no prior knowledge of the results of the official a.A.a. analysis.

TABLE XX. A COMPARISON BETWEEN TWO STUDIES ON ANALYSES OF BULLS IN ARTIFICIAL SERVICE

Study No. 1 - The data for this study are those which were collected in the questionnaire sent to every artificial insemination association in the United States. This study was completed in 1959.

Study No. 2 - This study was conducted by Mr. William A. Weeks (41) on analyses of bulls in ten midwest bull studs. These data were derived from a.A.a. office records and were compiled in 1958.

Number of Bulls in Each Analysis Category[1]

Study	Bloodline	SSS	SSR	SRS	RSS	SRR	RSR	RRS	RRR	Total
No. 1	Burke	3.0	11.0	9.0	3.0	25.0	3.0	10.0	15.0	79.0
No. 2	Burke	2.4	4.7	12.6	2.4	26.9	4.7	9.5	15.8	79.0
	χ^2	0.150	8.447**	1.032	0.150	0.134	0.617	0.026	0.041	10.597
No. 1	Carn.-Homest.	5.0	13.0	1.0	5.0	6.0	8.0	0	3.0	41.0
No. 2	Homestead	5.7	13.5	0.8	1.2	4.1	12.7	0.8	2.1	41.0
	χ^2	0.086	0.019	0.050	12.000**	0.878	1.740	0.800	0.386	15.959*
No. 1	All bulls	51.0	65.0	40.0	22.0	71.0	38.0	25.0	49.0	361.0
		50.5	75.8	43.3	21.7	57.8	39.7	21.7	50.5	361.0
	χ^2	0.005	1.538	0.252	0.004	3.014	0.073	0.502	0.046	5.434

[1]Study No. 2 was figured on a comparable basis to study No. 1.
*Significant ($P < 0.05$)
**Highly significant ($P < 0.01$)

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS
COLLEGE STATION - BROOKINGS, SOUTH DAKOTA

DIVISION OF AGRICULTURE
DAIRY HUSBANDRY DEPARTMENT

January 19, 1959

APPENDIX II.

Dear Sir:

We are conducting a study of a.A.a. (Animal Analysis Associates) for a research problem. I understand that your herd has been analyzed. We would appreciate it if you would supply us with some information needed for part of this study. All information that is given will be kept confidential as to your herd identity.

As you probably know, the a.A.a. system of analyzing is widely used, but there has been very little data gathered on it. The purpose of this project is to gather as much unbiased information as possible and then tabulate the results. The results of this study should be interesting and will be available.

We would appreciate it if you will answer the questions on the other sheets and return them to us.

Thank you very much.

Yours very truly,

Basil Eastwood

Basil Eastwood
Graduate Assistant

BE:bjm
Enclosures: 2

Name _____ Date _____

1. Do you think that analyzing has merit as a tool in the breeding of better dairy cattle?

   Yes _____ No _____

2. Do you believe that any good cow man could learn to analyze?

   Yes _____ No _____

3. Does the analysis information on your herd supplement the classification information, or take the place of it?

   Supplements it _____ Replaces it _____

4. Would you be willing to cooperate in a more detailed study involving your entire herd? This would include type and production information, calf losses, etc. This information would also be kept confidential as to your herd identity.

   Yes _____ No _____

5. Would you like a summary at the conclusion of this project?

   Yes _____ No _____

6. Do you have any comments or any suggestions as to topics that should be studied in our detailed study of analysis?

7. List below any analysed cows you have ever had in your herd that have both classified V.G. or higher and produced over 600# B.F. actual production. Also give the registration number of the cow, analysis of the cow, and analysis of the sire and dam of the cow.

Barn Name	Reg. No.	Her Anal.	Sire's Anal.	Dam's Anal.

8. List below any analyzed cows you have ever had in your herd that have both classified Fair or lower and produced less than 400# B.F. Also give the registration number of the cow, analysis of the cow, and analysis of the sire and dam of the cow.

Barn Name	Reg. No.	Her. Anal.	Sire's Anal.	Dam's Anal.

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS
COLLEGE STATION - BROOKINGS, SOUTH DAKOTA

DIVISION OF AGRICULTURE
DAIRY HUSBANDRY DEPARTMENT

June 18, 1959

Dear Sir:

For the past several months we have been gathering information from Holstein breeders on the a.A.a. (Animal Analysis Associates) system of analyzing dairy cattle. I am enclosing another copy of the sheets we sent out and hope that you will find the time to fill them out and return them to us.

It is essential that we get a response from a high percentage of the breeders sent to. The better the response the more valuable the information will be. We will appreciate your answering this questionnaire. If you would like a copy of the results of this study please indicate this on the sheet. Thank you for your trouble.

Yours very truly,

Basil Eastwood

Basil Eastwood,
Grad. Assistant

B.E.:lh
Enc.

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS
COLLEGE STATION - BROOKINGS, SOUTH DAKOTA

DIVISION OF AGRICULTURE
DAIRY HUSBANDRY DEPARTMENT

November 25, 1959

Dear Sir:

We are making the final tabulations on our study of the a.A.a. (Animal Analysis Associates) system of analyzing dairy cattle. We are getting some interesting results from this study but find that we must hear from all of you breeders in order to make the study complete.

I am enclosing a self-addressed, stamped, postcard which I hope you will check and return as soon as possible.

Thank you for your trouble.

Very truly yours,

Basil Eastwood,
Graduate Assistant

CHECK ONE

_____ I believe the aAa system has merit in the breeding of better dairy cattle.

_____ I do not believe the aAa system has merit in the breeding of better dairy cattle.

_____ I have not formed an opinion on the merits of the aAa system.

_____ I do not understand the aAa system.

Postcard which accompanied letter of November 25, 1959.

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS
COLLEGE STATION - BROOKINGS, SOUTH DAKOTA

DIVISION OF AGRICULTURE
DAIRY HUSBANDRY DEPARTMENT

June 26, 1959

Dear Sir:

On our first survey on the s.A.s. analysing system you indicated a willingness to cooperate with our detailed study. I am enclosing a copy of these sheets and hope that you will read through them and fill out as much of the information on your herd as possible.

We greatly appreciate your cooperation with us on this project and hope that the information we can gather will be of benefit to all concerned.

Very truly yours,

Basil Eastwood

Basil Eastwood
Grad. Assistant

BE:dh
Enc.

Name_____ Address_____

1. Number of cows of milking age in your herd_____.

2. When was your herd analyzed for the first time? 19____

3. In the blanks below fill in the number of cows in your herd in each analysis breakdown from the last time you analyzed and also from the first time you had your herd analyzed.

	RRR	RRS	RSR	SRR	RSS	SRS	SSR	SSS
Latest analysis								
First analysis								

4. Do you show any cattle at the local, state, or national shows?

yes_____ no_____

5. Have you noticed any difference in the overall body balance of the animals resulting from the recommended matings as compared with your other animals? Do you have any comments on this?

On the following pages please write in the analysis of the animals in your herd that are described by each statement and then write in the analysis of the sire and dam of each. Even though the analysis of the sire and/or dam may not be available write in the analysis of the individual.

Note: Please be sure that the numbers on pages 5 and 6 are used for the same cows.

6. Very aggressive feeder

Her anal.	Sire's anal.	Dam's anal.

7. Finicky slow feeder

Her anal.	Sire's anal.	Dam's anal.

8. High strung, nervous

Her anal.	Sire's anal.	Dam's anal.

9. Dull or stolid

Her anal.	Sire's anal.	Dam's anal.

10. Chronic mastitis trouble

Her anal.	Sire's anal.	Dam's anal.

11. Calving trouble

Her anal.	Sire's anal.	Dam's anal.

12. Cows that milk out faster than their dams did at the same age.

Her anal.	Sire's anal.	Dam's anal.

13. Cows that milk out cleaner or more completely than their dams at same age.

Her anal.	Sire's anal.	Dam's anal.

14. Tender feet-Lies down much of time or stands in the gutter.

Her anal.	Sire's anal.	Dam's anal.

15. Hard Milker.-Small teat opening.

Her anal.	Sire's Anal.	Dam's Anal.

16. Leaks milk for reasons other than injury.

Her anal.	Sire's anal.	Dam's anal.

17. Cows that freshened with blind quarter at first freshening.

Her anal.	Sire's anal.	Dam's anal.

18. Cows or [illegible] sold for beef or butchered for reasons other than old age.

Her anal.	Sire's anal.	Dam's anal.

19. Milks out fast. (Less than 4 min.)

Her anal.	Sire's anal.	Dam's anal.

20. Milks out slow (Over 8 min.)

Her anal.	Sire's anal.	Dam's anal.

21. Stepping on own teats.

Her anal.	Sire's anal.	Dam's anal.

22. Cystic ovaries.

Her anal.	Sire's anal.	Dam's anal.

23. Cows or heifers that died for reasons other than old age.

Her anal.	Sire's anal.	Dam's anal.

24. Calves that were born dead.

Sire's anal.	Dam's anal.

25. Calves that died after birth.

Sire's anal.	Dam's anal.

26. Grey colored animals.

Own anal.	Sire's anal.	Dam's anal.	Was sire grey?	Was dam grey?

27. Animals with black areas showing red or rust tinge.

Own anal.	Sire's anal.	Dam's anal.	Did sire show a rust tinge?	Did dam show a rust tinge?

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS
COLLEGE STATION - BROOKINGS, SOUTH DAKOTA

DIVISION OF AGRICULTURE
DAIRY HUSBANDRY DEPARTMENT

APPENDIX III.

May 9, 1959

Dear Sir:

We are conducting a survey of all of the Artificial Insemination Associations to find out how widely the aAa (Animal Analysis Associates) program is being used in the artificial breeding industry. The information you give will be kept confidential as to your identity.

We would appreciate it if you would fill out the enclosed sheets and return them to us. We are also interested in obtaining any other information available on your bulls, such as pedigrees, and provings.

Very truly yours,

Basil Eastwood,
Grad. Assistant

Name of Association_____

Manager_____

1. Have any of your bulls been aAa analyzed?

2. Do you publish the analysis information on your bulls in your literature?

3. What is your impression of patron interest in the aAa analysis of your bulls?

4. Do you believe that the aAa program could help the artificial breeding industry by providing patrons with analysis information on the bulls?

5. Approximately what percent of your patrons breed according to aAa recommendations?

6. Do you have any further comments concerning aAa?

If your bulls have been analyzed, we would appreciate the following information on them.

Barn Name or Number	Analysis	Breed	Blood-line	Estimated Weight	Classification information						
					FC	Pts.	GA	DC	BC	F&L	R

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS
COLLEGE STATION - BROOKINGS, SOUTH DAKOTA

DIVISION OF AGRICULTURE
DAIRY HUSBANDRY DEPARTMENT

June 10, 1959

Dear Sir:

For the past several weeks we have been gathering information from the artificial insemination associations to help us in a study we are conducting. I am enclosing another copy of the sheets we sent out and hope that you will find the time to fill them out and return them to us.

It is essential that we get a response from a high percentage of the associations sent to. The better the response the more valuable the information will be. Your cooperation will be greatly appreciated.

If you have already returned the first sheets we sent, thank you and please disregard this letter.

Yours very truly,

Basil Eastwood
Grad. Assistant

APPENDIX IV.

COMMENTS RECEIVED FROM BREEDERS ON a.A.a.*

"I realy (really) believe that a classification program followed by a study to determine the weakness that a person has in his herd would be much the same and easier to understand."

"In the thirty years that I have been breeding Holstein cattle, I have noticed (that) a sharp cow would milk off her fat while a round one would not. If you just keep on breeding sharp cattle year after year, you wind up with cattle that will milk like a house afire and get so poor in five or six months they just about go dry."

"The last two years we made an attempt to breed every cow to a bull of the exact opposite of her analysis, either from one of the four bulls we had or if none of ours were right, we made a select mating to a bull in a stud. We had calves and yearlings from six or seven bulls, and I am sure that an outsider would have thought that they were sired by only one or two bulls. While we did very little classifying, I think that it has merit after analysis. Analysis will tell you what an animal has or hasn't. Classification tells you to what degree."

"I have heard breeders say that a cow is a poor or a non-transmitter even though she has several offspring in sight. Of course their meaning is clear, but to me it's a challenge; instead of saying, no good, I say we have bred her wrong, or in other words, we must find a male with the characteristics in his genes that complement the cow's genes....When I think of drainage from the reproduction organs, it seems to me that a sloper (sloped rump) could have as much function and desirable characteristics as the straight (rump); in fact it's natural for all our animals to slope - the horse, the goat, sheep, dogs, pigs, etc. I think in our desire to not have slopers we went too strong and fast in selecting straight top lines and the result has been narrow pins and hips."

"I conclude that any cow bred to the right bull can result in an improvement; I know this is a broad statement but whenever the genes cooperate sufficiently in the matings of exact opposites that are the same degree from the supposed center the results will be gratifying."

"No matter what the classification or analysis, a cow bred to the opposite will give improvement in type. Production, while using a.A.a., is

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*Only a small representative cross-section of the comments received are included here. Each paragraph includes comments from one breeder. Comments are presented here in the same form in which they were originally given.

simultaneously maintained through bloodlines and records of sires and dams as usual."

"Weight of the animals or degree from "center" is almost as important as analysis itself. To properly pass judjment (judgement) on the analysis theory this must be taken into account. For instance, mating a cow that is so all SSS that she is classified 70 points to a bull that is all RRR, but just barely (lets say an Excellent 92 pts. bull) will eight out of ten times get you a calf about 76 to 78 points, while if you mated her to an all RRR bull that is so round he is "pudgy", scoring about 76, you would probably produce a calf that will score close to 86 to 89 points. This thing <u>really</u> works."

"We do not consider the analysis program comprehensive enough to serve as an adequate substitute for carefully selecting individual matings. We feel that it oversimplifies breeding cattle."

"I'm certain that any good cow man could learn to analyze, but only after thorough study and experience with cattle. I certainly believe that it will find its place to a much greater degree due to general public acceptance. In speaking for the Holstein-Friesian breed, I feel that we can usually say that like begets like, etc.; however, in our various breakdowns in confirmation (conformation), we find that there are varied types of Excellents, Very Goods, etc. Every breeder has the large and open cow standing along-side the compact and short-coupled cow, and yet they often score the same. We recognize that we should breed away from conformity weaknesses, hence we feel that an analysis provides a quicker way to solve our breeding problems."

"I question how much you can tell comparing according to classification with the variation there is in classification. I believe the value of the a.A.a. work will depend on keeping little variation between work done by the different men."

"I consider analysis to be the only sound tool that has helped us in the breeding of our cattle. I have excluded testing for that is not in the same field as analysis in my judgement."

"When Mr. Weeks analyzed my herd he brought to us something that has helped in selecting sires since then. It did us a lot of good in this respect."

"The big mistake in breeding from just the classification standpoint is that too many breeders breed Excellents to Excellents without knowing what is wrong with them. If we have a real thick cow that is Excellent, she should never be mated to a bull from a real thick cow or himself thick. In analyzing we hope to do away with this kind of mating."

"A good cow man can do a better job in someone elses herd than his own. We hate to admit our wrong at home."

"I believe that the analysis is a very feeble supplement to the official classification and frankly am surprised at the way it appears to flourish. However, it does show how much dairymen and experienced breeders are looking for any straw that will help them in this important matter of relating type to production. Possibly another factor is that the men doing the analyzing work have been carefully chosen and are widely respected."

"I feel quite strongly that not any good cow man could learn to analyze. Not just any good cow man can learn to classify nor can any good cow man judge a cattle show. In my opinion a.A.a. is even more specialized than classification or judging."

"Classification, I believe, has served its purpose well, but we need something like a.A.a. to get results. Breeding Ex. to Ex. or VG doesn't get the same kind."

"One thing seems certain. Analysis will not make a good bull out of a poor one! With analysis we can eliminate some of the breeding mistakes."

"When breeding cows artificially we think this program (a.A.a.) becomes more necessary, as most farmers don't get a chance to see the daughters of the sires they are using and very well could be using animals very wrong for their herd."

"It seems there should be a use of small letters and capitals or some such way of denoting degree of sharpness or roundness."

"From observing my own animals and those in other herds, those that are bred opposite or nearly opposite are by far larger, healthier, have better production records and longevity. Analysis is definately (definitely) a program to work with, rather than against, by breeders poor or rich. The results obtained from analysis will be in exact relation to how closely and correctly the persons using analysis followed it. For years bulls have been condemned for tearing down herds while actually it was man's mismating of the two animals that did the harm. That is where bull provings can be misleading, since minus bulls can become plus and plus bulls minus depending upon how nearly opposite in body structure the bull used is from the animal bred by that bull. Where farmers tend to breed in cow families, it is essential that they use bulls opposite to the animal bred, or get outside that family where they can find a bull opposite to the animal being bred."

"I believe with classification and good cow sense one can get along without a.A.a. If using all artificial breeding then it may be another thing if herd was analyzed."

"Mr. Weeks could spot an animal resulting from a perfect mating without knowing the sire and dam. They do seem to blend better in body parts and are more confortable appearing."

"Others have remarked how uniform our cattle are since we have used balanced matings. When they come uniformly good from three to five different bulls we're on the right track."

"The No. 1 matings seem to have better overall balance, stronger appearing calves and mature cows. Seems to work out very well."

COMMENTS RECEIVED FROM ARTIFICIAL INSEMINATION ASSOCIATIONS ON a.A.a.*

"The use of a.A.a. may make the breeder a bit more type conscious."

"It (a.A.a.) is only one of many tools that should help but it is not a major factor for improvement if we realize that (1) Too few dairymen keep records of identification, type, and production. (2) Most do not make the most of their cows for breeding replacements (they veal heifer calves, breed to beef bulls, or sell young heifers before they can evaluate them). (3) Most progress in breed improvement is made by groups and not by individuals, that is, what a bull will do on a group of cows is more predictable and more important genetically than what he will do when used on any individual cow. Averages are still our best measure of breeding worth since some hereditary characteristics are quantitative and all are subjected to the laws of chance."

"We are more confident that the official breed programs, in continuing their development, will more fully provide the needs of our breeder-dairymen."

"Except for scattered enthusiasm on the part of a few of our good breeders we have found a decline in the demand for this information during the past year or so. Personally, I feel it has considerable value if properly used; and that it might be the reverse if used indiscriminantly (indiscriminately)."

"Interest is spotted, mainly I believe since so few really understand what it is all about. A number of the purebred herds and some of the grades are attempting to make use of it. The basis of analysis is for both the cows and bulls to be analyzed. If the a.A.a. program has any merit and if the breeders have their herds analyzed, then it would follow that studs would be helping the artificial breeding industry by analyzing their sires and publishing the results. I believe that this program is too new in most areas to be able to show results in large numbers. While our sires have been analyzed in the main breeds because it was requested by several breeders, we do not believe that at this stage of the game we should take a stand for or against it. We want it to prove its merits."

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*Only a small representative cross-section of the comments received are included here. Each paragraph includes comments from one association. Comments are presented here in the same form in which they were originally given.

"Only purebred breeders are interested. This, of course, is a small percentage of business. We are using it primarily as a selling point."

"We see no reason for such a program when all major dairy breeds have an official type classification program which definitely describes in detail all parts of the animal."

"Analysis is growing, and the more we talk about this method of improving type the more interest is generated. a.A.a. is not 100 percent perfect but what is? I expect it is nearly as accurate as trying to use official classification. I personally became interested myself because I believed in breeding rounds vs. sharps to get better type before I ever heard of a.A.a. However, it takes cow sense and good judgment to go along with a.A.a. Breeding rounds with sharps is better than nothing, and it doesn't make much difference where the members get the information as long as they understand the analysis work. I personally believe it would be more helpful if a.A.a. did 50 to 100 daughters of a bull before the bull was analyzed, but this isn't practical. Round vs. sharp consideration of blood lines, cow families, test, size, etc., plus the fact members are becoming type conscious can certainly help to improve dairy type and the artificial co-ops do need a plan."

"The lack of other proven effective methods has made this system sell to farmers."

"There are more factors far more important that dairymen should understand before going into analysis of his herd, such as bull proofs, classification, and herd record keeping."

"a.A.a. has helped some purebred breeders overcome their blind devotion to "linebreeding" and to select mates by "merit" (?) instead of pedigree names. For this, a.A.a. is to be commended, and it is probably their biggest contribution to livestock improvement. They have succeeded in making outcrossing glamorous. a.A.a. itself is entirely misleading due to over simplification (dumping many separately inherited characteristics into one package) and the lack of progeny test in evaluation of sires. The only reasonable explanation for their moderate success is the personnel involved."

"Just a few purebred breeders know anything about it. We are afraid it will just confuse the commercial men by trying to explain it to them. The commercial men won't have their cows analyzed and our technicians don't know how to do it so what good is it to them."

"Most patrons would not know how to use the analysis information on the bulls. To do so, the dairyman must have his cows rated, too. Many tools are available to breeders of cattle. Each must be used in its proper perspective. a.A.a. can be used as a guide when breeders are aware of the degrees of "roundness" and "sharpness" in their cattle as well as the sires. It is not the magic formula that some have expected it to be, but it has gotten many to think of the cow first when selecting a sire to

use. a.A.a. does tend to avoid mating similar extremes together. It takes the basic breeding principle of mating the cow to a bull that is strong where she is weak and puts it into a simple, more usable form. The weakness of a.A.a. lies in matching letters without thinking the mating through and determining why. A counterpart to this is the breeder who puts together pedigrees instead of breeding cattle and considering the pedigree in its proper perspective with all of the other tools available to him. This has been oversold by its proponants (proponents). We have taken a conservative position. We will not publicly promote a.A.a."